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**WATER AFTER WAR: SECURING A LASTING PEACE**

by

Debora C. Richert  
Department of Army

COL James Pierce  
Project Advisor

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U.S. Army War College  
CARLISLE BARRACKS, PENNSYLVANIA 17013

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## ABSTRACT

AUTHOR: Debora C. Richert

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Useable water is in short supply in Iraq. Ecologically, economically, and politically, water is a finite resource out of balance with the needs of man and nature. With 80% of the available water being consumed by irrigation, this shortage of water will have an increasingly adverse impact on the region which is growing by 3.2% each year. For the south of Iraq, where an entire marshland ecosystem has collapsed, the continued diversion of water will ensure the permanent desertification of the remaining marshland environments and the extinction of many animal species.

This research paper looks at the issues concerning the Tigris and Euphrates rivers, which are the major suppliers of surface water to Iraq, Turkey, and Syria. Because these rivers also comprise the largest transnational river system in southwest Asia, the degraded quantity and quality of water within these river basins is an important issue for discussion. While Iraq may be considered water rich by regional standards it does not manage its water effectively. After the war, the reconstruction government in Iraq must re-evaluate its sources of water, its uses and control of water, and ultimately seek regional water sharing plans with its neighbors for future use, and seriously consider alternative sources of water such as desalination in the south to support future oil production.

Short term, aid and assistance to Iraq must be directed at rebuilding water treatment infrastructures, and introducing new agricultural practices. Over time, leaders must find a way to restore recoverable areas in the southern marsh systems and remove poorly designed water impoundment systems.



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## **WATER AFTER WAR: SECURING A LASTING PEACE**

This paper assesses the impact of upstream-downstream relationships between Turkey, Syria and Iraq over water management, water quality, and regional water ventures that are directed toward economic growth and population expansion. One consequence of the growth in Turkey and Syria, is that both countries feel justified impounding water from the Tigris and Euphrates rivers to the detriment of Iraq as a downstream receiver of water. This research paper evaluates the consequences and impact that the impoundment of the Tigris and Euphrates rivers has had on Iraq.

This paper analyzes the negative inter-relationship between regional growth and degradation of water quality. With the growth in urban populations and expanded agricultural enterprises the Tigris and Euphrates rivers are becoming increasingly polluted. Especially hard hit is Iraq as the down stream receiver of polluted water from Turkey and Syria.

This paper examines some of the actions taken by Saddam Hussein to use water as a weapon against his own people. The research highlights the consequences of Hussein's actions, specifically in terms of the ecological damage to his country. The focus is on agricultural practices, and the destruction of the southern marshes as a result of his policies to divert water away from the marshes.

This paper concludes with proposed actions that Iraq can take with Turkey and Syria to reverse the general decline in water quality as well as water quantity. The key to all proposals is the development of a comprehensive water sharing plan that is equitable for regional growth. There are also recommendations for actions that can be taken within Iraq to stem or reverse the ecological damage and destruction that is so prevalent today.

### **WHY IS WATER IMPORTANT**

The Tigris and Euphrates rivers are transnational rivers shared by Turkey, Iraq and Syria. These two rivers are polluted with herbicides, and pesticides from irrigation water discharged into the rivers, and untreated industrial wastes being discharged from urban areas. Because Iraq does not have enough operating water treatment plants, large portions of its population are at risk for waterborne illness and disease.

Regional growth depends on adequate water for hydroelectric generation, irrigation and domestic consumption. Turkey, Iraq and Syria are all competing for the same water to meet those needs. The current demand for water by these three countries is greater than the combined volume of the Tigris and Euphrates rivers. Irrigation is one of the biggest consumers

of resources in all three countries. Irrigation consumes an average of 80% of all water available.

Saddam has also diverted water out of the southern marshes to the point where they are no longer self-sustaining. As a consequence of removing the water, Saddam has effectively displaced the Marsh Arabs, a remnant population of the old Mesopotamian culture. Less than 10,000 indigenous people remain in the marshes, and up to 100,000 Marsh Arabs have fled to Iran as refugees. Another 100,000 Marsh Arabs are scattered around the world as political refugees.<sup>1</sup> Restoration of the marshes and repatriation of the Marsh Arabs will be an expensive challenge facing Iraq after regime change.

### **THE LAND BETWEEN TWO RIVERS, AN AGRICULTURAL CONUNDRUM**

As one of the cradles of civilization, Iraq has a long and rich history of cultures with a strong agricultural heritage. For example, six thousand years ago, Mesopotamia rose up as a powerful state with a central government based on agriculture and the control of water. Mesopotamia was a permanent settlement located between the Tigris and Euphrates rivers. Because the area between the rivers was nourished by river sediment, the Mesopotamians were able to grow an abundance of crops. By constructing a series of dams, canals, and embankments, the central government was able to use water as a source of social and political influence.

When Mesopotamia first constructed their water control systems, they used the Euphrates river to draw the water and the Tigris river to drain the water. As long as the control systems were maintained this type of system was very efficient in maintaining soil fertility. Over time the population of Mesopotamia grew and there was more pressure to put additional land under cultivation. In successive years the central government was unable to maintain the complex system of canals and embankments. As a result, the canals and embankments slowly deteriorated adversely affecting the way water was delivered and discharged. Consequently, soil fertility declined as water logging and salinity levels increased. Ancient records dating back to 4,000 B.C. show that crops were being switched to more alkaline tolerant species. By 3,500 B.C., there was a 50/50 split between wheat and barley. By 2,500 B.C., the more salt-tolerant barley represented 80% of the crops grown, and by 1,700 B.C. wheat could not be grown at all because of the salt accumulation in the soil.

Mesopotamia as a state collapsed, and the canals, dams and embankments eventually fell apart. Over successive generations the importance of agriculture declined and it wasn't until the mid twentieth century that agriculture regained its importance in Iraq. When Saddam came

to power, his central government began an aggressive campaign to control water for political and military advantage just like the Mesopotamians 6,000 years ago. The consequences of his actions and policies are the basis for this paper.

In central Iraq for example, canals were constructed to divert water from both the Tigris and Euphrates rivers to farms owned by supporters of Saddam. The central government deliberately manipulated the water in order to gain political favor. Saddam also used water as a weapon to punish southern Iraqi's (Ma'dan or Marsh Arabs) after the Gulf War. By manipulating the water through dams, canals and embankments Saddam was able to effectively drain the water out of the marshes in less than 15 years.

Descendents of the Sumerians and Babylonians, the Ma'dan or Marsh Arabs have a rich cultural history. The Marsh Arabs have historically "acted as a link between present inhabitants of Iraq and the peoples of ancient Mesopotamia."<sup>2</sup> The Marsh Arabs as a distinct ethnic group, continued to pursue their unique life style even as Iraq fought with Iran over the Shatt-al-Arab basin on the gulf, and later with the Americans in the Gulf War. When the Gulf War ended, the Marsh Arabs rose up against Saddam Hussein but were defeated by his military. In response to the uprising, Saddam Hussein decided to punish the Marsh Arabs by deliberately draining the marshes where they had lived for centuries. Through the construction of dams, embankments, and canals Saddam diverted the flow of the Tigris and Euphrates rivers around the marsh. As a result, the Marsh Arabs have been driven out of the marshes and are now a displaced refugee population scattered within Iraq and into Iran.

To understand the conundrum of agriculture in Iraq, one has to understand the limitations of Iraq's geology to support extensive cultivation. During the 1940-50's, American and European engineers worked with Iraq to design flood and irrigation control systems to decrease the likelihood that arable lands would be lost to water-logging and soil salinity. Because of the topography and soil characteristics in Iraq, this plan was necessary to ensure adequate supplies of fresh water for irrigation. The original plan called for engineers to capture the irrigation runoff and divert it away from the fields into separate canals and then to discharge that water into the southern marshes where it could be filtered.

Iraq did implement some of the engineering plans for agriculture, but they did not implement many of the comprehensive aspects of the plan to control the salinity in the rivers. In terms of agricultural opportunities, Iraq had enough land to grow crops and be self-sufficient in the 1950's. Over the length of the 20<sup>th</sup> century Iraq, slowly moved away from self sufficiency toward more reliance on importation of food products. For example, in the 1960's Iraq began importing about 15% of its food, and by the late 1970's the importation ratio had grown to about

a third of the total food requirement. In 1989, about 20% of Iraq's population was engaged in agriculture, and food products accounted for about 5% of Iraq's GDP.<sup>3</sup>

Irrigated areas in central and southern Iraq have degraded due to water logging and salinity. Estimations of soil fertility show that 4% of the arable land is severely saline, 50% is medium saline and 20% slightly saline. With a total of 74% of the land suffering from some degree of salinity in Iraq, the ability to grow a variety of crops is limited. Iraq has been successful with some crops and fruit trees. For example, date palms can be grown under moderately saline conditions, and tomatoes can be irrigated with brackish groundwater.<sup>4</sup>

After the Gulf War ended, sanctions were imposed on Iraq that made it necessary to grow more crops within the country to feed the people. Because Iraq had been a net importer of food prior to the Gulf War, this sudden shift in agrarian priorities caused some short term shortages in food because of the lack of farmers. During the 1980's Saddam Hussein had paid farmers not to farm, instead, encouraging them to move to the cities and work in the industrial sector. As a result much of the arable land was left fallow. With the political turmoil after the Gulf War, farmers were encouraged to return to their farms. Because they did not have access to new equipment or technology they continued to rely on old agricultural traditions and practices.

With increased cultivation and over-application of water and chemicals to the land, the predictions made by engineers in the 1940-50's (about salinity reducing soil fertility and soil arability) came true. According to the Central Intelligence Agency, World Factbook, 2002, only 1% of the arable land is being cultivated with permanent crops.

Looking at the factors affecting agriculture in general, it is apparent that there are two issues directly impacting water quality. The first issue is the lack of proper drainage systems. Without a comprehensive approach to drainage system construction, the used irrigation water does not properly drain off the soil. As a result, soil and water salinity increased and productivity decreased over time.

The second issue is that farming practices have not changed much over the years, and farmers are still over irrigating their fields which causes soil salts to rise to the surface. Farmers are also applying more pesticides and herbicides than needed in an attempt to increase crop yields. The consequences of applying too many of these chemicals, or applying them at the wrong time is that they run off the land and into the river, degrading the quality of the water.

After viewing the agricultural practices in Iraq, Hassan Partow, Information and Research Officer for the United Nations Environment Programme, concluded that the deterioration in water quality was because "human irrigation practices are rendering the Tigris and Euphrates waters saltier than they originally were."<sup>5</sup> It is important to point out that water quality problems

begin in Turkey and Syria. Through dam construction, more water is available to farmers for irrigating marginal land in Turkey. As a result, farmers who were used to farming in near drought conditions could now grow more crops and apply more water, pesticides and herbicides. As a consequence of rotating crops and growing more cotton river salinity and pollution load has increased.

According to Patrick Clawson, director for the Washington Institute of Near East Policy, “what Saddam’s regime has done to agriculture in a region that historically was called the Fertile Crescent and birthplace of civilization represents a level of incompetence unimagined in the world.”<sup>6</sup>

Over the years, Iraq constructed several large water impoundment projects along the Tigris river to provide flood control, irrigation, storage and hydroelectric generation. The massive Tharthar diversion reservoir in central Iraq, for example, was constructed in the mid-1950’s and gets its recharge from the Tigris River. This reservoir accounts for 69% of Iraq’s gross storage capacity and farmers depend heavily on the water stored in the reservoir for their agricultural needs.<sup>7</sup> The reservoir also protects Baghdad from flooding from the Tigris river.

The construction of 4 large dams inside Iraq and even larger ones constructed in Turkey and Syria have significantly reduced the risk of flooding in Iraq. It is possible that some of the smaller water control structures in Iraq are now obsolete and could be deconstructed. When unwanted control structures have been removed, Iraq could then regulate the rivers in a way that more closely mimics normal flow conditions and reduce salinity levels.

Looking ahead, Iraq must address the limited amount of arable soil it has available for future land use. A comprehensive recovery plan for Iraq will include processes that address and prioritize actions that achieve balance between ecological, agricultural, and urban needs. Because water is a finite resource in this region, and because water quality is declining due to overall poor regional agricultural practices, Iraq must re-look the original 1940-50’s engineering plans and assess what obsolete water control systems can be deconstructed.

The total collapse of the wetland/aquatic marsh system cannot be understated in terms of its impact on southern Iraq. This marsh system was a critical component of the Tigris and Euphrates river basin, and constituted the lower portion of the old Mesopotamia region in the lower reaches of the Fertile Crescent. The southern marshes once provided agricultural benefit both within the marsh and along its outer fringes. The southern marshes also provided filtration of river sediments before the rivers discharged into the gulf. This unique filtering system once sustained extensive nursery beds for shrimp.

## **SOUTHERN MARSHES, THE STEADY DECLINE UNDER SADDAM HUSSEIN**

An important theme throughout this research paper is the loss of the southern marshes. Historical and current events have shaped the marsh story. After Iraq's independence in the 1940's, American and European engineers helped design plans to construct irrigation drainage systems to carry away salt and excess water from areas under cultivation. There was an awareness at that time that the southern marshes could be drained to free more land for agriculture. At the time the plans were developed, these marshes and wetlands were the largest co-mingled habitat in the Middle East and Western Eurasia.<sup>8</sup>

While Iraq did not actively seek to drain the marshes until after the Gulf War, it did implement one of the largest elements of the engineering plan, a canal called the "Third River." It was built between 1953 and 1992 and ran between the Tigris and Euphrates rivers, crossing under the Euphrates before exiting to the gulf. The "Third River" is the first Iraqi project that would eventually be linked to Saddam Hussein's aggressive plan to divert and prevent the flow of water into the marsh complex. During the 1980's, Saddam Hussein constructed dams and levees in certain parts of the marsh in an effort to remove the water and provide dry access for drilling new oil wells.

Some hydrological experts have opined that the long-term effects of water retention by upstream dams might actually have contributed to the breakdown and ultimate disappearance of the marshland ecosystems. But, they all agree that the accelerated scale and speed of the marshland disappearance was mainly driven by the massive drainage works undertaken by Saddam Hussein.<sup>9</sup>

Before Saddam came to power, Iraq's southern marshes were one of the most extensive natural wetland ecosystems in Europe and Western Asia. By 2001, the southern marshes which once covered 7,725 square miles had been reduced to less than 10% of their original size and received less than 20 percent of the original flow from the Tigris and Euphrates rivers. Once the rivers were diverted from the marshes no spring flood waters reached the marshes. As a result, the marshes were not flushed or recharged.

What was once described as a lush and teeming environment the size of New Jersey, is now the size of a small island in the Bahamas.<sup>10</sup> According to the Marsh Arabs who fled to Iran, the marshes are now "a landscape where people struggle through deep mud, water is underground and unsafe, waste accumulates, and food is scarce."<sup>11</sup>

Why did Saddam target the southern marshes in the first place? There is evidence that Saddam Hussein drained the marshes in an attempt to deny the Shi'ite Muslims (Marsh Arabs) sanctuary after they rose up in revolt after the Gulf War in 1991.

During the ten years after the Gulf War, Saddam had constructed the Saddam River which opened in 1992, the Prosperity River which opened in April 1993, Crown of Battles River and the Mother of Battles River which opened in April 94, and finally the Fidelity of the Leader Canal which opened in December 1997.<sup>12</sup>

Considering the size of these ancient marshes, it took a full 10 years before the outside world became aware of the level of destruction Saddam had perpetrated by draining the marshes.

Inherent in the destruction of these marshes is the ultimate disappearance of an ancient wetland/aquatic ecosystem. In Iraq alone, 97% of the Central marsh is gone, and 94% of the Al Hammar marsh is gone. The Hawr Al Hawizeh/Al Azim marshes which straddle the Iran-Iraq border are also disappearing.<sup>13</sup> The water that recharges these marshes comes from the Karun river in Iran. When Iran opened the Karkheh Dam on the Karun river in 2001, there was a significant reduction in the amount of water entering the marshes. Landsat photography taken in 2002, shows the northeastern shore of the marshlands in Iran retreating, and the southeastern sections of the marsh along the Iran-Iraq border completely dried out.<sup>14</sup>

During the 11<sup>th</sup> Stockholm Water Symposium on August 13, 2001, United Nations Environment Programme's Executive Director, Klaus Topfer described the wetlands' condition as "a major environmental catastrophe that will be remembered as one of humanity's worst engineered disasters."

"As the destruction of the marshlands progressed through the 1990's, many endemic mammal populations collapsed. The average depth across most of the marshland was about three feet. It supported salt-tolerant reeds and a great variety of aquatic vegetation. Many fish species of scientific and commercial value lived in the shallow and deep-water lakes found throughout the marshes. The marshes have traditionally been home to wild boars and mongoose, jackals, turtles, snakes, ducks and countless migratory birds. Several endemic species of mammals, birds, fish have already become extinct in recent years. Three mammal species threatened with global extinction live here – the Grey Wolf, the Long-fingered Bat and a subspecies of the Smooth-coated Otter. There are about 40 migrating bird species at risk of future declines."<sup>15</sup>

The marshes also provided a hydrologic balance against the Persian Gulf. Because there is no water in the marshes, the water from the Persian Gulf is now eroding away the edges of the marsh and destroying old sediment beds that are critical for shrimp nurseries. The inland and freshwater ecosystems have collapsed.<sup>16</sup>

Coastal fisheries that were dependent on the marshland habitat are also collapsing along the Arabian/Persian Gulf. The collapse for Iraqi fisherman over the last ten years is significant in terms of lost opportunities. The United Nations, Farming and Agriculture Organization estimated 60% of Iraq's inland fish catch in 1990 was caught in the marshes.<sup>17</sup>

Another adverse impact of destroying the marsh is that nursery grounds for migrating salt water fish and crustaceans no longer exist. With approximately 40% of Kuwait's shrimp catch originating in the southern Iraqi marshes, the degrading sediment formations in the Shatt-al-Arab basin may become a transnational issue between Kuwait and Iraq.<sup>18</sup>

Saddam Hussein, when confronted about the destruction of the marshes has contended that drying the marshes has freed up more land for agriculture. Satellite imagery taken in 2001 does not support his claims. What the imagery shows is dried marsh areas with very little cultivation. Experts think the reason the land is not being cultivated is the buildup of salts and minerals in the exposed soil.<sup>19</sup>

### **CAN THESE MARSHES BE SAVED**

A standing recommendation throughout this research paper is to recognize the value of water both in human and ecological terms. In order to restore the marshes, Iraq must seek ways to restore a balance in the delivery of water, starting with Turkey and Syria and finally from within Iraq itself. Alex Kirby, Environmental Correspondent for the British Broadcasting Company, said in 1991, "the world has no more fresh water today than it did 2,000 years ago when the population was less than three percent of its present size"<sup>20</sup>

The harsh reality for Iraq is that the southern marshes may not be salvageable. It may be possible to restore small fragments of the marsh but restoring an entire ecosystem that has been under attack for ten years is doubtful. At a minimum Iraq must increase the flow of water into the marshes. To start the process Iraq needs its neighbors to increase the amount of water that is released from the Tigris and Euphrates dams in order to mimic a more natural river flow.

Second, Iraq needs to look at its own water control systems to see where more water can be made available. By reversing Saddam's water policies and removing the dykes, canals, and embankments it may be possible to gradually reintroduce water in a way that allows for a natural restoration of the marshes.

From a health and safety standpoint, restoration must also be accompanied by a thorough investigation and determination of whether Saddam Hussein's troops, under his direction, mined the recently constructed dams, levees, and embankments in the marshes. The investigation must also include ground and surface water sampling and soil sampling. The results from this

testing will be invaluable to restoration experts in determining what types of contaminants might have been left in the marshes as well as any possible poisons that might have been used.

Until water can be reintroduced into the marshes, it is highly probable that any dust storms that originate in or around the marshes will carry potentially contaminated sediments into populated areas. It is also probable that the contaminants might cause respiratory illnesses.

## **THE GULF WAR YEARS, FOULING THE WATER**

Assessing current events is important when trying to understand the competing demands for water between Turkey, Syria and Iraq. This research paper uses historical as well as current perspectives to assess the power of water in the transnational river basin of the Tigris and Euphrates rivers.

While recent disagreements between these countries have not led to open warfare over water, they do illustrate the high degree of tension between the countries. When the United States targeted and destroyed several dams and water treatment facilities during the Gulf War it introduced a new degree of tension in Iraq. Now, in addition to poor water quality from pollutants, Iraq has been unable to provide safe drinking water to a majority of its population. For example, in 1991 100% of all urban areas had safe drinking water, but 54% of rural areas still relied on ground water which was less safe. With the Gulf War and its aftermath the situation has deteriorated.<sup>21</sup>

Reporters began writing about America's war objectives when they gained access to information from official papers and interviews. One example of America's war objective was in an article that appeared in the Sunday Herald (Scotland), September 17, 2000. In the article it stated, "during allied bombing eight multi-purpose dams were repeatedly hit, wrecking flood control, municipal and industrial water storage, irrigation and hydroelectric power. Four of the seven major pumping stations were destroyed, as were 31 municipal water and sewerage facilities – 20 in Baghdad, resulting in sewage pouring into the Tigris. Water purification plants were incapacitated throughout Iraq."<sup>22</sup>

Life in the city did not get any better after the Gulf War ended. According to a Red Cross report prepared in February 2000, for the United Nations, there appeared to be an overall deterioration in the quality and quantity of drinking water resulting in the rapid spread of infectious diseases, such as cholera in central and southern Iraq.<sup>23</sup> Iraqi leadership has been slow in repairing damaged water treatment facilities and infrastructure.

Over the last ten years, Iraq has complained that it couldn't get repair parts to fix the treatment plants, and that chlorine remains in short supply. As a consequence, they say they

cannot provide adequate treatment of waste water or potable water. Some critics have accused the United States government of using sanctions against Iraq to prevent the importation of this equipment and necessary disinfectant chemicals. The United States contends that chlorine is a dual use chemical and it will not approve the purchase of chlorine because it could be made into a weapon of mass destruction.

Iraqi engineers outside the country are contending that Saddam's regime, "has allowed the drinking water system to collapse, particularly those of the southern cities of Karbala and Najaf, in order to discourage the growth of politically active Shi'ah urban centers. They counter that if Saddam Hussein had used the money and expertise he expended draining the southern marshes, the regime could have rapidly rebuilt all the pumping stations it claims were damaged in the Gulf War."<sup>24</sup>

In sharp contrast to the plight of Sunni and Shi'ah Arabs in central and southern Iraq, the northern Kurds have made progress in repairing and replacing their water treatment and sanitation systems. According to the Washington File, the Minister of Reconstruction and Development, Nasreen Sideek, the Kurds have been able to construct 1,500 new water treatment systems in rural and urban areas over the last ten years.<sup>25</sup>

Iraqi leadership has continued to deny any responsibility for failing to respond to emerging and chronic health risks. The Deputy Prime Minister of Iraq suggested to attendees at the 2002 Earth Summit in Johannesburg, South Africa, that Iraq's environmental woes were tied to international sanctions and the effects of coalition bombing in 1991.

No matter who is at fault in central and southern Iraq, the sanitation problems keep Iraqi people at risk. Water in most urban areas remains polluted and Iraqi children along with the sick and the elderly are susceptible to amoebic dysentery, gastroenteritis and other waterborne diseases.

## **GETTING THE WATER, IRAQ AND THE DAM BUILDERS**

As stated in previous sections, Iraq must continue to talk with its neighbors about how much water it needs to support its projected growth rate and economic needs. The first formal water agreements between countries was in the 1920's when Turkey, France and Great Britain agreed to safeguard water entering Iraq from both the Tigris and Euphrates rivers.

In 1946, Turkey and Iraq were working together to figure out how much water would be provided to Iraq as Turkey began constructing dams in the Euphrates river. Called the Treaty of Friendship and Good Neighborliness, it encouraged countries to talk about water requirements before dams were constructed. This treaty was the last formal bilateral agreement to protect

water availability into Iraq. In 1980, the Joint Technical Committee on Regional waters (Tigris and Euphrates rivers) was created. This committee allowed Turkey and Iraq (Syria joined the committee in 1983) to build upon the earlier 1946 protocol for control and management of the rivers. Following in 1990, was the Iraq and Syria agreement that dealt with controlling and managing water from the Euphrates river only.<sup>26</sup>

There are 30 major dams built on the Tigris and Euphrates rivers. In the 1960's, Turkey started the planning process for controlling the rivers. By 1970, the upper and middle reaches of the Euphrates river were controlled with the construction of the Keban, Karakaya, Karababa, and Ataturk and Tabqa dams. After the completion of the Ataturk dam in 1989, the total controlled capacity of the Euphrates river was 80%.<sup>27</sup>

In 1983, Turkey launched the Southeast Anatolia Development Project (GAP), a 50 year project to provide irrigation water to 40 percent of its arable land located in the southeast Anatolia region. The GAP includes a series of 22 dams and 19 hydroelectric plants.<sup>28</sup> When the GAP is completed the impact will be significant. River flow from the Euphrates will be reduced approximately 40% to Syria and 80% to Iraq.<sup>29</sup>

Without a coordinated water sharing plan in place, these countries will permanently alter the river basin ecology to satisfy their agricultural and energy needs. The aggressive competition for water is apparent looking at current dam construction along the rivers. In 2000, there were eight dams under construction, and at least 13 more planned.<sup>30</sup>

Turkey is complaining it might need to impound more of the Tigris river so it can meet its projected agricultural needs. During the planning for the GAP, regional planners anticipated the benefits more water would have in drought prone areas. With additional water the planners expected farmers to increase crop yields. With the additional water available, farmers built canals to deliver water directly to their fields. The overabundance of water encouraged over-irrigation of the fields and consequently increased soil salinity. Many farmers now grow cotton because it is a state subsidized crop. Unfortunately, cotton also consumes a large amount of water. Without Turkish attention to water conservation, farmers will continue to consume more water than necessary and artificially drive up Turkish demands for water.

If Turkey goes ahead and constructs more dams on the Tigris to meet artificially inflated agricultural needs, it will increase tensions between itself and Iraq. As the least dammed river in the basin, Iraq depends on the Tigris for most of its surface water needs. With half the water in the Tigris originating in Turkey, Iraq has little ability to prevent Turkey from impounding the water while it is still in Turkey.

In 1998 the Iraqi National Assembly “denounced what is said was Turkey’s inappropriate use of Tigris and Euphrates waters.” By 1999, Iraq and Syria had signed another water sharing accord, to send an important message to Turkey about their concern as littoral countries in sharing the Euphrates river.<sup>31</sup>

The concern about dam construction on these transnational rivers is usually about the cost benefit each nation gains after the water is impounded. From the United Nations, Environmental Programme’s perspective, current activities along the Tigris and Euphrates river basin confirm a total lack of cooperation between countries to share water in a way that promotes a sustainable, long term perspective.

Regional cooperation has never been very successful in the region. When the World Bank funded the Ataturk dam in Turkey, it required Turkey to prepare a water management plan in consultation with the downstream countries to address the availability of water when the dam was completed. In 1984, Turkey completed the required water management plan and submitted it to Syria and Iraq at one of the Joint Technical Committee meetings, neither country has signed on to the plan.

Since 1983, these three countries have held sixteen ministerial and Joint Technical Committee meetings to discuss water issues. Unfortunately, no formal water cooperative agreements have ever come out of these meetings. Iraq and Syria remain suspicious of Turkey’s motives, and view Turkey’s impoundment of water as a regional threat .

This was not a surprise to the United Nations. As early as the 1970’s they recognized the potential for conflict to erupt over water in countries where the resource was shared. The first steps to open dialogue between Turkey, Syria and Iraq began with the loan procedures and requirements of the World Bank. Broader steps were taken by the International Law Commission in 1994 when it submitted the first set of draft Articles to be applied to the Law of the Non-Navigational Uses of International Watercourses. Interestingly enough, some of the same principles that showed up in those draft Articles were first articulated in the 1984 Turkish water plan submitted to Syria and Iraq.

The Turkish plan included language that mirrored Article 5, calling for the use of trans-boundary rivers to be equitable, and reasonable; Article 6, defining equity not as equal distribution but as a decision based on a wide range of factors; Article 7, stating that water use not cause significant harm to others; and Articles 8 and 9, calling for cooperation and regular exchange of information between riparian states.<sup>32</sup>

Even though Iraq and Syria refuse to agree to the 1984 water sharing plan, Turkey has maintained that its dams have a beneficial effect on water flow into Iraq and Syria. Turkey

contends that the dams regulate the amount of water released, and ensure adequate water to Iraq and Syria even during drought conditions. Turkey also asserts that the dams stabilize the amount of water released during flood conditions.

Despite Turkey's best efforts to assure adequate water and stability in the region there is no guarantee that the rains will come or snow will fall. In an average year, the Euphrates's river capacity is an estimated 31,820 million cubic meters, a quantity that can satisfy the demands of all three countries. But a lack of rainfall in 1989 caused the Euphrates river level to fall to 16,870 million cubic meters and Iraq, Syria and Turkey suffered serious water shortages.<sup>33</sup>

To keep the water dialogue open between Syria and Iraq, Turkey did call a summit meeting in 1991 to discuss regional economic sustainability issues to include water as an integral component of regional security and stability. In that meeting, Turkey proposed to initiate efforts which would result in definitive water use requirements for each country into the future. Unfortunately, no action was initiated by any country to make that proposal a reality.

### **DERIVING WATER EQUITY, IRAQ'S FAIR SHARE**

How much water is enough water? That depends on what country you ask. Turkey has always enjoyed the advantage over Syria and Iraq to extract water first from the Tigris and Euphrates rivers because both originate in the Eastern Anatolia region of Turkey.

Turkey claims sovereign rights over all the water in the Tigris and Euphrates rivers. Turkish leadership has stated over the years that their right to the Tigris and Euphrates rivers is absolute and that Arab states have no more right claiming Turkey's water then Turkey has claiming their oil.

Turkey bases the majority of its water requirements on energy generation and agriculture. Turkey argues that it has to irrigate more crops to sustain a larger population then either Syria or Iraq. Turkey also relies on hydroelectricity to power its cities and industry.

What water is not impounded by Turkey flows through Syria into Iraq, and directly from Turkey to Iraq. A future challenge for Iraq will be getting enough water flowing out of Turkey and Syria into Iraq. If Turkey, Syria and Iraq were to actually extract all the water they are currently demanding, there would not be enough water to go around. For example, Syria wants 32 percent of the Euphrates and 5.4 percent of the Tigris. Iraq wants 65 percent of the Euphrates and 92.5 percent of the Tigris. Turkey wants 52 percent of the Euphrates and 14.1 percent of the Tigris.

Because there is no regional water management plan between these countries, they are free to establish their own demands against different sets of criteria. As a result, their demands

for water far exceeds the carrying capacity of the Tigris and Euphrates rivers combined. Numerically, the total flow capacity of the Euphrates is exceeded by 49 percent and the Tigris by 12 percent.<sup>34</sup> Iraq is the most vulnerable country because its demands for water are contingent on Syria and Turkey not taking the full 100% of the water they have demanded.

What will happen if there is not enough water to go around? Within the last 30 years, there have been incidences where Iraq and Syria have gone so far as conflict brinkmanship over the control, or the lack of control, of water. In 1975, for example, both Turkey and Syria completed two major dam projects on the Euphrates river and began impounding water. In response to the decrease in river flow Iraq mobilized its armed forces at the border of Syria threatening to destroy the al-Thawra dam. Iraq claimed that the two impoundments had reduced the flow of the Euphrates by 90% and adversely affected three million farmers. Though no actual combat erupted over the water impoundment it did raise the issue of upstream versus downstream water control.<sup>35</sup>

In 1990, Turkey completed the Atatruk dam and nearly dried up the Euphrates river in order to fill the lake in front of the dam. Because Iraq faced water shortages as a result of Turkey diverting Euphrates water, they joined with Syria to plan an armed retaliation against Turkey. In response Turkey who had planned to divert the water for a month, returned the Euphrates river to normal flow after only three weeks.<sup>36</sup>

It is unlikely that Iraq will go to war over water with Turkey or Syria. Since the Tigris and Euphrates rivers are considered transnational rivers, they do not fall under any international law that covers apportionment of water. This ambiguity means that Iraq has little chance of using international law to force concessions from Turkey or Syria for reasonable and equitable apportionment of water as they claim is their right.<sup>37</sup>

## **CREATING A WATER BALANCE BETWEEN COUNTRIES**

In order for Iraq to efficiently use the water that it has access to from the Tigris and Euphrates rivers, it needs to develop more efficient ways to expand its agricultural and industrial base. One way would be to seek funding for small-scale irrigation and watershed management and conservation projects through the World Bank. Based on recent lending patterns six percent of small-scale irrigation and watershed management and conservation projects get funded by the World Bank. As the largest donor to the World Bank, the United States could highly encourage them to fund Iraqi projects.

The United States has pledged to help rebuild Iraq after the war. The United States has the technical and intellectual resources it needs to push for a comprehensive regional water management plan between Iraq, Turkey and Syria.

“A passive governmental approach to Middle East water scarcity will doom any future peace initiative. Middle East hatred is bountiful but Middle East water is at the point of no return. It is vital to the economic and political survivability of the region to sit down at the negotiating table.”<sup>38</sup>

A United States presence in Iraq will change the balance of power in the region. It will take away some of the geographic balance of power Turkey and Syria have used in the past to dictate water policy to Iraq. Politically, the United States can pressure Turkey and Syria to work with Iraq on the proposed water sharing plan agreement proposed back in 1984. The plan, if adopted, would establish the Tigris and Euphrates rivers as one system instead of two, and it would set the criteria for a common inventory of water and land resources in the basin area. From that inventory all three countries could establish water allocation requirements that would then be equitably distributed.

One other action that Iraq could take is to make available the combined waters of the Tigris and Euphrates rivers at the Tharthar diversion reservoir. Because the Tigris is the less controlled of the two rivers, its waters combined with the Euphrates could ensure adequate water is available to irrigate arable lands and might result in a more balanced approach to water availability. With the balancing of water between the rivers in Iraq, all three countries could reasonably expect to meet future agricultural objectives. If the countries cannot agree however, then the impact may be monumental in terms of ecological destruction.

#### **IRAQ MOVING AHEAD, RECOMMENDATIONS FOR THE FUTURE**

Restoring a balance between human and ecological dependency on water will be an important post war objective. Reversing the damage that polluted waters pose to humans and the environment along the stretches of the Tigris and Euphrates rivers will take a significant shift in regional priorities.

“Iraq is a classic example of the domino effect of water scarcity on the environment and human population. In a classic environmental hierarchy, water scarcity leads to environmental degradation; increased mortality, reduced quality of life, diminished agricultural production, and diminished industrial production.”<sup>39</sup>

The conservation of water will need to have the same level of importance in all countries. Because Turkey does not have oil resources, Iraq could use resource sharing of their oil as an

alternative for energy generation in Turkey. In return there could be agreements with Turkey to reduce dam construction on the Tigris river.

Water control projects constructed by Saddam in the southern marshes must be realigned to restore water to the marshes and to accomplish the original objectives outlined in the 1940-50's engineering designs. Farming practices which currently use 80% of the available fresh water in Iraq would need to be modified using current technologies such as drip irrigation, or recycled water applications.

In order to successfully accomplish these objectives, Iraq must first focus on how much water it needs for regional stability, economic growth, and eventual restoration of the southern marshes. Because Iraq had to desalinize about a quarter of all its ground and surface water prior to the Gulf War, it will have to continue treating water into the future. Using high cost ion exchange or reverse osmosis systems is the traditional way of desalinating the water, but there may be other alternatives for providing clean drinking and industrial water. Iraq might consider reclaiming and treating waste water for industrial and irrigation requirements.

Concurrently, as other countries are economically impacted by poor water practices in Iraq, such as Kuwait's shrimping industry, there needs to be regional talks about compensation until such time as the marshes can be restored to some level of ecological balance. As Paul M. Wihbey, an Adjunct Fellow in Strategic Research at the Institute for Advanced Strategic and Political studies correctly points out, "The integration of water into the emerging frameworks for strategic cooperation could facilitate the protection and preservation of water resources and pave the way for the long-term security of Middle East water."<sup>40</sup>

Iraq needs to push efforts to revive interest in the 1984 Turkish water sharing and management agreement between Turkey, Syria and itself. Iraq also needs to encourage Iran to join the Joint Technical Committee as a regional partner. Regional countries could reaffirm the principles in the agreement to respect the rights of each country to equitable and reasonable use of the trans-boundary rivers; to agree that the distribution of water will be equal based a established set of common criteria; to agree that no country will implement an action that would cause significant harm to others; and, to agree that riparian countries will continue to cooperate with each other and have regular exchanges of information. This particular recommendation would also apply to Iran because of its southern reaching rivers.

After formally affirming the principles in the Turkish agreement they could then begin the necessary inventory to determine water requirements. Understandably, this effort will entail a lot of scientific and practical expertise from within their countries and from the United States. This inventory when completed, will contain data on each countries evaporation rates,

temperature and rainfall. Concurrent with the inventory collection each country needs to determine land use classifications and drainage requirements resulting from agricultural activities.<sup>41</sup>

From this information, these three countries could then devise a cooperative water use plan that wouldn't exceed the carrying capacity of the Tigris and Euphrates rivers yet would satisfy their requirements for water. A positive outcome of this kind of comprehensive approach to water management might be the recognition and application of water conservation practices during irrigation.

At the same time that Iraq is coming to grips with managing its available surface water needs, it also needs to look at alternative sources of water to meet the demands of industry in southern Iraq. It may not be practical in the long run to rely on the Tigris and Euphrates rivers to supply the water for both the marshes and urban/industrial areas in southern Iraq. With access to Gulf water, Iraq should seek international aid to construct desalination plants to supply water. While desalination is an expensive alternative for providing clean water, the amount and quality of water coming out of the Tigris and Euphrates rivers makes this a preferred long term solution.

Prior to constructing any desalination plants, Iraq should work with its neighbors Kuwait and Saudi Arabia to get advice and guidance on construction, design, and contaminant load management. Because of the fragile ecosystem in the delta area, Iraq will certainly need to employ an alternative disposal system for the desalination process wastes. Iraq should consider disposing of desalination waste byproducts into new or existing wastewater treatment facilities.

Not only would cities such as Basra benefit from this new source of clean water but the oil production industry would also benefit from having clean water to refine oil. Industry experts are already warning that water pollution without adequate treatment is affecting oil production.<sup>42</sup> With access to desalinated water, oil industries could increase the production and development of southern oil fields.

In order to fund all this reconstruction and restoration Iraq must rely on its rich oil reserves. Rebuilding the oil industry is the best ways to finance Iraq's return to democracy and some sort of prosperity, says Fadhil Chalabi, a former Secretary General of the Organization of Petroleum Exporting countries and a member of the Iraqi exile group.<sup>43</sup>

Many of the recommendations made in this research paper have been technical in nature and require studies to gather data to make decisions. Others simply require lots of money and expertise to construct and destruct water control structures. Everything is doable given time and money.

WORD COUNT= 7,580

## ENDNOTES

<sup>1</sup> U.S. Department of State, International Information Programs, "Iraqi Regime's Assault on the Environment," available from <http://usinfo.state.gov/regional/nea/iraq/focus/environment.htm>; Internet; accessed 3 March 2003, 2.

<sup>2</sup> United Nations Environmental Programme, "The Mesopotamia Marshlands: Demise of an Ecosystem," 15.

<sup>3</sup> Food and Agricultural Organization of the United Nations, Land and Water Development Division, "AQUASTAT, FAO's Information System on Water and Agriculture," available from <http://www.fao.org/ag/agl/aglw/aquastat/countries/iraq>. Internet; accessed 27 November 2002, 2.

<sup>4</sup> Ibid.

<sup>5</sup> United Nations Environmental Programme, "The Mesopotamia Marshlands: Demise of an Ecosystem," ix .

<sup>6</sup> James Fisher-Thompson, "Saddam's Overthrow Would Liberate Iraq's Economy, Experts Note," 26 September 2002, available from <http://usinfo.state.gov/regional/nea/iraq/focus/htm>; Internet; accessed 14 December 2002.

<sup>7</sup> United Nations Environmental Programme, "The Mesopotamia Marshlands: Demise of an Ecosystem," 9.

<sup>8</sup> Ibid, 11.

<sup>9</sup> Ibid, 36.

<sup>10</sup> U.S. Geological Survey, EROS Data Center, "Iraq-Kuwait 1972, 1990, 1991, 1997," 12 January 2001, available from: <http://edc.usgs.gov/earthshots/slow/Iraq/Iraqtext>; Internet; accessed 10 December 2002, 2.

<sup>11</sup> U.S. Geological Survey, EROS Data Center, "Iraq-Kuwait 1972, 1990, 1991, 1997," 2.

<sup>12</sup> United Nations Environmental Programme, "The Mesopotamia Marshlands: Demise of an Ecosystem," 25.

<sup>13</sup> Ibid, 29, 32.

<sup>14</sup> Ibid, 33.

<sup>15</sup> Earth & Sky, "Dry Crescent," Byrd and Block Communications, Inc., 4 November 2002, available from <http://www.earthsky.com/2002/es021104.htm>; Internet, accessed 15 April 2003, 2.

<sup>16</sup> United Nations Environmental Programme, "The Mesopotamia Marshlands: Demise of an Ecosystem," 33.

<sup>17</sup> Ibid, 20.

<sup>18</sup> Ibid, 35.

<sup>19</sup> U.S. State Department, "Background Note: Iraq," December 2001, available from <<http://www.state.gov/r/pa/ei/bgn/6804.htm>>; Internet; accessed 10 December 2002, 5.

<sup>20</sup> Gar Smith, "Water Wars, Water Cures," © Earth Island Journal, Spring 2000, [journal on-line], available from: <<http://yeoldeconsciousnessshoppe.com/art8.html>>; Internet; accessed 26 November 2002, 1.

<sup>21</sup> Food and Agricultural Organization of the United Nations, Land and Water Development Division, "AQUASTAT, FAO's Information System on Water and Agriculture," 4.

<sup>22</sup> Felicity Arbuthnot, "Allies Deliberately Poisoned Iraq Public Water Supply in Gulf War," Common Dreams News Center, 27 November 2002, available from: <[www.commondreams.org/headlines/091700-01.htm](http://www.commondreams.org/headlines/091700-01.htm)>; Internet; accessed 27 November 2002, 1.

<sup>23</sup> Press Release for House of Representatives, "Kucinich, Members of Congress Ask Albright for Meeting on Iraq Sanctions Policy," 18 April 2000, available from <<http://www.house.gov/kucinich/press/iraq.html>>; Internet; accessed 17 December 2002, 1.

<sup>24</sup> U.S. Department of State, International Information Programs, "Iraqi Regime's Assault on the Environment," 3.

<sup>25</sup> Vicki, Silverman, "Straight Talk About "The Day After" Saddam," Washington File, 23 November 2002, 1.

<sup>26</sup> Food and Agricultural Organization of the United Nations, Land and Water Development Division, "AQUASTAT, FAO's Information System on Water and Agriculture," 3.

<sup>27</sup> United Nations University, "Managing Water for Peace in the Middle East," The Tigris and Euphrates Rivers 2.2, available from <<http://www.unu.edu/unupress/unupbooks/80858e/80858E04.htm>>; Internet; accessed 12 February 2003, 1.

<sup>28</sup> Department of Energy, Fossil International, "An Energy Overview of the Republic of Turkey," available from <<http://www.fe.doe.gov/international/turkover.html>>; Internet; accessed 12 December 2002, 9.

<sup>29</sup> Ilan Berman and Paul Michael Wihbey, "The New Water Politics of the Middle East," Strategic Review, Summer 1999, [journal on-line], available from: <<http://www.israeleconomy.org/strategic/water.htm>>; Internet; accessed 27 November 2002, 3.

<sup>30</sup> United Nations Environmental Programme, "The Mesopotamia Marshlands: Demise of an Ecosystem," 9.

<sup>31</sup> Radio Free Europe ©, Radio Liberty, "Iraq Report", 13 April 2001, available from <http://www.rferl.org/iraq-report/2001/04/12-130401.htm>; Internet; accessed 27 November 2002, 2.

<sup>32</sup> Republic of Turkey, Ministry of Foreign Affairs, "A Scramble for Water Resources is Under Way in the Middle East," available from [www.mfa.gov.tr/grupa/ac/aci/default.htm](http://www.mfa.gov.tr/grupa/ac/aci/default.htm); Internet; accessed 12 February 2003, 9.

<sup>33</sup> Joyce R. Starr, "Water Wars," *Foreign Policy*, Spring 1982, available from: <http://www.ciesin.org/docs/006-304/006-304.html>; Internet; accessed 26 November 2002, 6.

<sup>34</sup> Republic of Turkey, Ministry of Foreign Affairs, "A Scramble for Water Resources is Under Way in the Middle East," 3-4.

<sup>35</sup> Joyce R. Starr, "Water Wars," 6.

<sup>36</sup> Adel Darwish, "Water Wars," Geneva Conference on Environment and Quality of Life, June 1994, available from <http://www.mideastnews.com/WaterWars.htm>; internet, accessed 23 December 2003, 7.

<sup>37</sup> Kent H. Butts, "The Strategic Importance of Water," *Parameters*, Spring 1997, [journal-online], available from <http://carlisle-www.army.mil/usawc/Parameters/97spring/butts.htm>; Internet; accessed 17 December 2002, 7-8.

<sup>38</sup> Joyce R. Starr, "Water Wars," *Foreign Policy*, Spring 1982, [journal on-line], available from <http://www.ciesin.org/docs/006-304/006-304.html>; Internet; accessed 27 November 2002, 9.

<sup>39</sup> National Defense University, Center for Environmental Security, "Summary Information from the Environmental Dimensions of Regional Security Workshop," 16 May 1996, available from <http://www.pnl.gov/ces/dialogue/516wkshp.htm>; Internet; accessed 13 January 2003.

<sup>40</sup> Yasemin, Dobra-Manco, "Eurasian Analysts Worried by Russian Assertiveness and Ineffective US Policy," *Washington/Istanbul- Turkish Daily News*, 5 February 2000, available from <http://www.israeleconomy.org/caspian/25tdn.htm>; Internet, accessed 4 December 2002, 2.

<sup>41</sup> Republic of Turkey, Ministry of Foreign Affairs, "Water Issues Between Turkey, Syria and Iraq," *PERCEPTIONS, Journal of International Affairs*, June-August 1996, [journal on-line], available from <http://www.mfa.gov.tr/grupa/percept/i2/i2-6.htm>; Internet; accessed 27 November 2002, 14.

<sup>42</sup> Department of Energy, Country Analysis Briefs, "Iraq," October 2002, available from <http://www.eia.doe.gov/emeu/cabs/iraqfull.html>; Internet; accessed 21 January 2003, 10.

<sup>43</sup> Adam Zagorin, "All About The Oil," *Time*, 17 February 2003. 34.



## BIBLIOGRAPHY

- Abdullah, Jaradat A. "Agriculture in Iraq: Resources, Potentials, Constraints and Research Needs and Priorities." U.S. Department of Agriculture, Agricultural Research Service. 5 November 2002.
- Al-Hassan, Omar. Water Resources in the Middle East. Gulf Centre for Strategic Studies, London. 1996.
- Arbuthnot, Felicity. "Allies Deliberately Poisoned Iraq Public Water Supply in Gulf War." Common Dreams News Center. 27 November 2002. Available from <[www.commondreams.org/headlines/091700-01.htm](http://www.commondreams.org/headlines/091700-01.htm)>. Internet. Accessed 27 November 2002.
- Ariga. "Two Rivals Draw Closer Together." Stratfor, Inc. 29 February 2000. Available from <<http://www.ariga.com/stratfor02292000.htm>>. Internet. Accessed 27 November 2002.
- Baron, Dror. "20 Years of Oppression." Michigan Review. 18 November 1998. Journal on-line. Available from <<http://www.umich.edu/~mrev/archives/1998/11-18-98/pg11b.htm>>. Internet. Accessed 12 February 2003.
- Beaumont, Peter. "Water – A Resource under Pressure." (on the Tigris-Euphrates system) G. Nonneman (ed.), The Middle East and Europe: The Search for Stability and Integration, 2<sup>nd</sup> ed., London, 1993. pp. 183-188.
- Berman, Ilan and Wihbey, Paul Michael. "The New Water Politics of the Middle East." Strategic Review. Summer 1999. Journal on-line. Available from <<http://www.israeleconomy.org/strategic/water.htm>>. Internet. Accessed 27 November 2002.
- Biswas, Asit, K. ed. International Waters of the Middle East. Oxford University Press, Oxford, 1994.
- Butts, Kent H. "The Strategic Importance of Water." Parameters. Spring 1997. Journal on-line. Available from <<http://carlisle-www.army.mil/usawc/Parameters/97spring/butts.htm>>. Internet. Accessed 17 December 2002.
- Central Intelligence Agency. "The World Fact Book 2002." 19 March 2003. Book on-line. Available from <[www.cia.gov/cia/publications/factbook/print/iz.htm](http://www.cia.gov/cia/publications/factbook/print/iz.htm)>. Internet. Accessed 10 December 2002.
- Chaulia, Sreeram. "The Iraqi Street Could Pay the Price for War." Asia Times. 31 July 2002. Newspaper on-line. Available from <[http://www.atimes.com/atimes/Middle\\_East/DG31Ak02.htm](http://www.atimes.com/atimes/Middle_East/DG31Ak02.htm)>. Internet. Accessed 12 February 2003.
- Darwish, Adel. "Water Wars." Geneva Conference on Environment and Quality of Life. June 1994. Available from <<http://www.mideastnews.com/WaterWars.htm>>. Internet. Accessed 26 November 2002.

- Defense Information Agency. "Iraq Water Treatment Vulnerabilities (U) as of 18 Jan 91 Key Judgments." January 1991. Available from <http://www.jacksonprogressive.com/issues/international/iraqwater.htm>. Internet. Accessed 27 November 2002.
- Department of Energy. Fossil Energy International. "An Energy Overview of the Republic of Turkey." Available from <http://www.fe.doe.gov/international/turkover.htm>. Internet. Accessed 12 February 2003.
- Department of Energy. Country Analysis Briefs. "Iraq." October 2002. Available from <http://www.eia.doe.gov/emeu/cabs/iraqfull.htm>. Internet. Accessed 21 January 2003.
- Dobra-Manco, Yasemin. "Eurasian Analysts Worried by Russian Assertiveness and Ineffective US Policy." *Washington/Istanbul- Turkish Daily News*. 5 February 2000. Available from <http://www.israeleconomy.org/caspian/25tdn.htm>. Internet. Accessed 4 December 2002.
- Earth & Sky ©. "Dry Crescent." 4 November 2002. Available from <http://www.earthsky.com/2002/es021104.htm>. Internet. Accessed 4 April 2003.
- Embassy, Republic of Turkey. "The Criteria Which Would Satisfy Each of the Three Countries in Allocating Transboundary Waters." Available from <http://www.turkey.org/governmentpolitics/issueswtcriteria.htm>. Internet. Accessed 27 November 2002.
- Environmental News Service. "Water Wars Not a Worry for World's Top Dam Expert. 18 August 2000. Available from <http://www.globalpolicy.org/security/natres/water/2000/0818asma.htm>. Internet. Accessed 26 November 2002.
- Fisher-Thompson, James. "Saddam's Overthrow Would Liberate Iraq's Economy, Experts Note." 26 September 2002. Available from <http://usinfo.state.gov/regional/nea/Iraq/focus/economy.htm>. Internet. Accessed 14 December 2002.
- Food and Agricultural Organization of the United Nations. Land and Water Development Division, "AQUASTAT, FAO's Information System on Water and Agriculture." Available from <http://www.fao.org/ag/agl/aglw/aquastat/countries/Iraq>. Internet. Accessed 27 November 2002.
- Fuller, Jim. "Iraqi Regime Devastates Environment of Marsh Arabs." *Washington File*, 24 April 2002. Available from <http://www.usinfo.state.gov/regional/nea/Iraq/focus/environment.htm>. Internet. Accessed 4 March 2003.
- Fuller, James. "Legal Expert Describes Iraqi Treatment of Marsh Arabs as Genocide." 18 November 2002. Available from <http://www.usembassy.org.uk/midest424.html>. Internet. Accessed 27 November 2002.

- Gleick, Peter. "Water Conflict Chronology." Pacific Institute for Studies in Development, Environment and Security. September 2000. Available from <<http://www.worldwater.org/conflict.htm>>. Internet. Accessed 26 November 2002.
- Goldie, Jenny. "Water Wars." Australian Centre for Independent Journalism. December 2000. Available from <<http://www.reportage.uts.edu.au/stories/2000/dec00/waterwars.htm>>. Internet. Accessed 26 November 2002.
- Horta, Korinna and Pottinger, Lori. "US Can Help Stop Brewing Water Wars." 27 January 1999. Available from <<http://www.irn.org/programs/lesotho/horta.html>>. Internet. Accessed 26 November 2002.
- Kolars, John. "The Middle East Growing Water Crisis." Research & Exploration, Volume 9. 1993.
- Marr, Phebe Dr. "Iraq After Saddam." Testimony for the Senate Foreign Relations Committee. 1 August 2002. Available from <<http://foreign.senate.gov/hearings/MarrTestimony080102.doc>>. Internet. Accessed 21 January 2003.
- Morris, Mary E. "Water Scarcity and Security Concerns in the Middle East." Emirates Centre for Strategic Studies and Research Occasional Paper. Number 14. 1998.
- Nagy, Thomas J. "The Secret Behind the Sanctions." September 2001. Available from <<http://www.progressive.org/0801issue/nagy0901.html>>. Internet. Accessed 27 November 2002.
- National Defense University. Center for Environmental Security. "Summary Information from the Environmental Dimensions of Regional Security Workshop." 16 May 1996. Available from <<http://www.pnl.gov/ces/dialogue/516wksbp.htm>>. Internet. Accessed 13 January 2003.
- Nestor, Carl E. "Kurdish water, Turkish fire: the Role of the Southeast Anatolian Project in the Social Integration of the Kurds into the Turkish State." The International Journal of Kurdish Studies. Journal on-line. Volumes 8 and 9. 1995-96.
- North, Andrew. "Saddam's Water War." Geographical Magazine. July 1993. Available from <<http://web.macam.ac.il/~arnon/Int-ME/extra/SADDAM%20wars.htm>>. Internet. Accessed 12 February 2003.
- Press Release by Congressman Dennis K. Kucinich. House of Representatives. "Kucinich, Members of Congress Ask Albright for Meeting on Iraq Sanctions Policy." 18 April 2000. Available from <<http://www.house.gov/kucinich/press/Iraq.htm>>. Internet. Accessed 17 December 2002.
- Radio Free Europe ©. Radio Liberty. "Iraq Report." 13 April 2001. Available from <<http://www.rferl.org/iraq-report/2001/04/12-130401.htm>>. Internet. Accessed 27 November 2002.

- Republic of Turkey. Ministry of Foreign Affairs. "A Scramble for Water Resources is Under Way in the Middle East." Available from <[www.mfa.gov.tr/grupa/ac/aci/default.htm](http://www.mfa.gov.tr/grupa/ac/aci/default.htm)>. Internet. Accessed 12 February 2003.
- Republic of Turkey. Ministry of Foreign Affairs. "Water Issues Between Turkey, Syria and Iraq." *PERCEPTIONS, Journal of International Affairs*. June-August 1996. Journal on-line. Available from <<http://www.mfa.gov.tr/grupa/percept/i2/i2-6.htm>>. Internet. Accessed 27 November 2002.
- Schultz, M. "Turkey, Syria and Iraq: A Hydropolitical Security Complex." Regional Case Studies of Water Conflicts (Padrigu Papers), Peace and Development research Institute, Gothenburg University. 1992.
- Shiva, Vandana. "Water Wars." South End Press 2002. Available from <[http://www.thirdworldtraveler.com/Vandana\\_Shiva/Water\\_Wars\\_Vshiva.htm](http://www.thirdworldtraveler.com/Vandana_Shiva/Water_Wars_Vshiva.htm)>. Internet. Accessed 26 November 2002.
- Silverman, Vicki. "Saddam Hussein has Destroyed 90 Percent of Iraq's Wetlands Heritage." 2 October 2002. Available from <<http://usembassy.state.gov/islamabad/www02100204.htm>>. Internet. Accessed 21 January 2003.
- Silverman, Vicki. "Straight Talk About "The Day After" Saddam." *Washington File*. 23 November 2002.
- Smith, Gar. "Water Wars, Water Cures." © Earth Island Journal. Spring 2000 Issue. Journal on-line. Available from <<http://yeoldeconsciousnessshoppe.com/art8.htm>>. Internet. Accessed 26 November 2002.
- Starr, Joyce R. "Water Wars." *Foreign Policy*. Spring 1982. Journal on-line. Available from <<http://www.clesin.org/docs/006-304/006-304.htm>>. Internet. Accessed 26 November 2002.
- United Nations Environmental Programme. "The Mesopotamia Marshlands: Demise of an Ecosystem." 15 August 2001. Report on-line. Available from <<http://svs.gsfc.nasa.gov/vis/a000000/a002200/a002210/mesopotamia.pdf>>. Internet. Accessed 21 January 2003.
- United Nations University. "Managing Water for Peace in the Middle East." The Tigris and Euphrates Rivers 2.2. Available from <<http://www.unu.edu/unupress/unupbooks/80858e/80858E04.htm>>. Internet. Accessed 12 February 2003, 1
- U.S. State Department. "Background Note: Iraq." December 2001. Available from <<http://www.state.gov/pa/ei/bgn/6804.htm>>. Internet. Accessed 10 December 2002.
- U.S. State Department, International Information Programs. "Destroying the Marshes." 7 May 2002. Available from <<http://usinfo.state.gov/regional/nea/iraq/crimes/crimes3.htm>>. Internet. Accessed 10 December 2002.

U.S. Department of State, International Information Programs. "Iraqi Regime's Assault on the Environment." Available from <http://usinfo.state.gov/regional/nea/Iraq/focus/environment.htm>. Internet. Accessed 3 March 2003.

U.S. Geological Survey, EROS Data Center, "Iraq-Kuwait 1972, 1990, 1991, 1997." 12 January 2001. Available from <http://www.edc.usgs.gov/earthshots/slow/Iraq/Iraqtext>. Internet. Accessed 10 December 2002.

Vaknin, Sam. "The Emerging Water Wars." Available from [http://www.nthposition.com/politics\\_water.html](http://www.nthposition.com/politics_water.html). Internet. Accessed 26 November 2002.

Villiers, de Marq. "Water Wars of the Near Future." ITT Industries. Available from <http://www.itt.com/waterbook/Wars.asp>. Internet. Accessed 26 November 2002.

Wolf, Aaron T. "Middle East Water Conflicts and Directions for Conflict Resolution." Department of Energy, Center for Environmental Security, International Food Policy Research Institute. March 1996.

Zagorin, Adam. "All About The Oil." Time. 17 February 2003.